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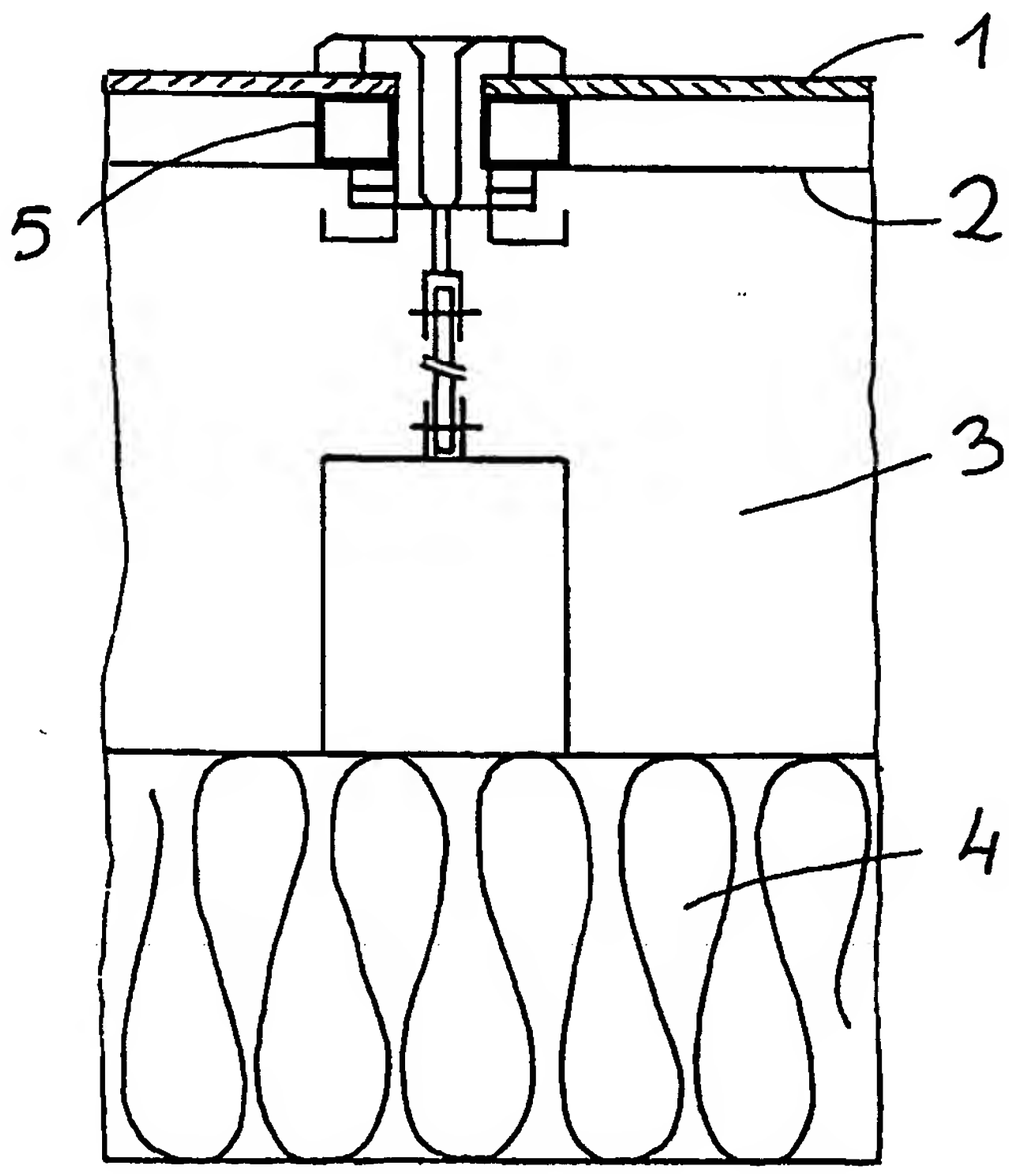
(54) Title: SOLAR THERMAL COLLECTOR ELEMENT

(57) Abstract

Solar thermal collector element for building integrated mounting in wall facades, sloped roofs as free standing units, etc. the solar absorber sheet (2) thereby being a sheet having substantially the same coefficient of thermal expansion as the glass pane (1), including a high internal thermal conductivity and a high heat absorbtion capacity from heat radiation, the absorber sheet (2) and the glass pane (1) being sealed and connected to each other by circumferential lists, e.g. spacers (5) in such a way that the solar absorber sheet (2) the glass pane (1) and the lists being a sealed closed building unit, the unit being adapted to be mounted at a distance from an insulated wall, the space (3) between the insulation (4) and the absorber sheet (2) being part of a duct system for heating and transporting air.



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Solar Thermal Collector Element

The present invention is related to a solar thermal collector element for building integrated mounting in wall facades, sloped roofs, as free standing units, etc.

Most air based solar collectors for space heating have traditionally been built on-site, composed in the following manner. Behind an outer layer of glass or plastics being arranged at a distance, a metal sheet - the solar absorber - normally from copper or aluminium, and further at a distance the rear insulated wall. The metal sheet is heated by the solar radiation.

The air between the metal sheet and the rear wall is then heated by the transfer from the solar struck and heated metal sheet, whereafter this air is circulated normally by a fan and removed via ducts to a room where the space is directly heated by the solar heated incoming air, to a mass, such as a wall, a floor or a space element for storing the heat, and/or to an air/water heat exchanger to supply hot water.

Traditionally over half the costs of a solar thermal system is related to the solar collector itself. A more rational production and installation of solar collectors have been complicated due to the fact that the metal absorber that normally has been used in such systems have had a completely different thermal expansion coefficient to that of the glass cover.

Traditionally the solar absorber sheet and the glass have been mounted as two separate layers with a flexible connection. Since the absorber sheet and the glass cover have so very different thermal expansion when the system is operating, sooner or later cracks will arise between them. Also the air locked between the two layers will expand and subtract at varying temperatures. When cracks arise, the construction starts "breathing", e.g. air leaks out and in. Over time dust will hence also enter and get stuck on the inside of the glass and the outside of the solar absorber sheet. The result is reduced solar absorbtion and reduced system efficiency. In worst case dew may form on the inside of the glass.

According to the present invention, however, a solar collector that allows factory manufacturing or even mass production and the joining of glass and the solar absorber sheet

into a complete solar collector unit that very easily can be mounted on site, is produced. This is achieved with the solar collector element according to the present invention as it is defined by the features stated in the claims.

Through the possibility of factory mass production of the solar collector unit according to the present invention, great advantages occur by the use of composites in ceramics, porcelain etc. with the selected colour resulting in increased architectural usefulness. At least with the darker of the colours the heat absorption from the sunrays will be practically as high as when using black colours.

The drawing discloses in figure 1 a perspective view on a section of a solar collector element according to the present invention and figure 2 discloses in a cross section the components of one typical embodiment of the collector element.

The solar collector element according to the present invention, consists of a glass pane 1 that is fixed and hermetically sealed with a rear solar absorber sheet 2 with approximately the same thermal expansion coefficient as glass. The two layers are mounted together at a distance of from a few millimetres to several centimetres. The rear layer, the solar absorber sheet 2, is furthermore especially well equipped to absorb solar radiation and lead/transfer the heat from the front side to the backside of the absorber sheet 2. The backside of the element hence will heat air in an air compartment 3 behind the absorber sheet 2, from which air is directed to desired places through ducts. Suitably the backside of the air compartment 3 comprises of insulation 4 to avoid or decrease heat losses.

The space behind the solar collector unit will vary in depth depending on the volume and speed of air circulating from this space via ducts to the indoor room or to the air/water heat exchanger.

The rear layer of the solar absorber sheet 2 can for example be composed by steel/ceramics, porcelain or of another type of composite or of another consistence. This combination allows the putting together of the glass-layer and the composite layer with rim lists, spacers 5 and glass/metal glue at an optimum distance to ensure maximum solar radiation and maximum thermal insulation against heat losses through outgoing radia-

tion. Furthermore a complete and durable tightening of the air gap between glass pane and absorber sheet is ensured, since the connection, e.g. glue etc, is not stressed unnecessary as a result of different thermal expansion coefficients for the two layers.

With this construction of the solar collector unit dust and dew problems are eliminated on surfaces that later will be unaccessible and hence totally impossible to maintain and clean.

Several types of materials with combinations of metal, glass, porcelain, ceramics and other materials can satisfy the requirements of thermal expansion, although a good solar collector also requires good thermal conductivity from the sunstruck side of the absorber sheet to its rear side. Aesthetics and durability also matters.

The manufacturing of the solar collector element can be carried out in the same manner as the manufacturing of sealed double glazing in so far as it is built up in the same manner except for the inner glass pane being exchanged for the solar absorber sheet made from steel, ceramics etc.

The glass pane, the solar absorber sheet and the lists, e.g. the spacers, are hence together composing a building element that contain a hermetically sealed unit that can be manufactured for the desired purpose and mounted in curtain wall like frames to cover wall facades or roofs. Since the solar collector element, according to this invention, is manufactured and handled very much like sealed glazing units, the unit can freely be used in all types of glazing facade and roof systems, and in all sizes.

The composite sheet can be manufactured in a selection of darker solar radiation absorbing colours that can be chosen to fit the colour scheme for the building or free standing unit in question. Such colours will not be degraded by solar radiation since they are made from non-organic materials. Durability and aesthetically pleasing appearance is hence ensured without loss of efficiency over time since no degrading occurs, like in most solar absorber sheet surfaces.

Due to the sealed construction dust build-up on the sunny side of the absorber sheet and on the inside of the glass is avoided.

Through the preferred solution of the invention the rear side of the solar absorber sheet is dark and can be roughened or vanes can be added to increase heat transfer to the air circulating behind the solar collector unit.

The solar collector unit according to the present invention is mounted for example in a wall or in the roof with a distance to a building surface on the outside of the wall or the roof insulation.

The collector element according to the present invention may be used in a number of different embodiments. The unit can for example be free standing, connected to a building with ducts in the air or on the ground.

The unit further can be integrated in a window shutter, under the roof tiles or it can be used as a sloping sunshade outside windows. The unit can be integrated in a complete wall or roof or in only part of it, in such a way that the collector elements will hardly be visible from the outside. The unit can be used for preheating ventilation air.

The solar heating system can be combined with facade or roof integrated solar electric photo voltaic (PV) systems that often has a need for ventilating the space behind the PV modules to cool these down and through this increase the efficiency of solar PV. The present invention can be combined with PV modules by using the heated air from the backside of the solar PV modules as the ingoing air into the solar thermal system. A preheating is thus achieved in the thermal system at the same time as cooling of the PV system occurs. A higher efficiency is hence resulting on both systems.

Patent Claims

1. Solar thermal collector element for building integrated mounting in wall facades, sloped roofs as free standing units, etc. **CHARACTERIZED IN** the solar absorber sheet (2) being a sheet having substantially the same coefficient of thermal expansion as the glass pane (1), including a high internal thermal conductivity and a high heat absorbtion capacity from heat radiation, the absorber sheet (2) and the glass pane (1) being sealed and connected to each other by circumferential lists, e.g. spacers (5) in such a way that the solar absorber sheet (2) the glass pane (1) and the lists being a sealed closed building unit, the unit being adapted to be mounted at a distance from an insulated wall, the space (3) between the insulation (4) and the absorber sheet (2) being part of a duct system for heating and transporting air.

2. Element according to claim 1, **CHARACTERIZED IN** the solar side of the absorber sheet (2) having dark colour.

3. Element according to claims 1-2, **CHARACTERIZED IN** the rear side of the absorber sheet (2) having dark colour.

4. Element according to claims 1-3, **CHARACTERIZED IN** the rear side of the absorber sheet (2) having a crude surface.

5. Element according to preceding claims, **CHARACTERIZED IN** the absorber sheet (2) being a composite plate, preferably made of combinations of steel, ceramics or porcelain.

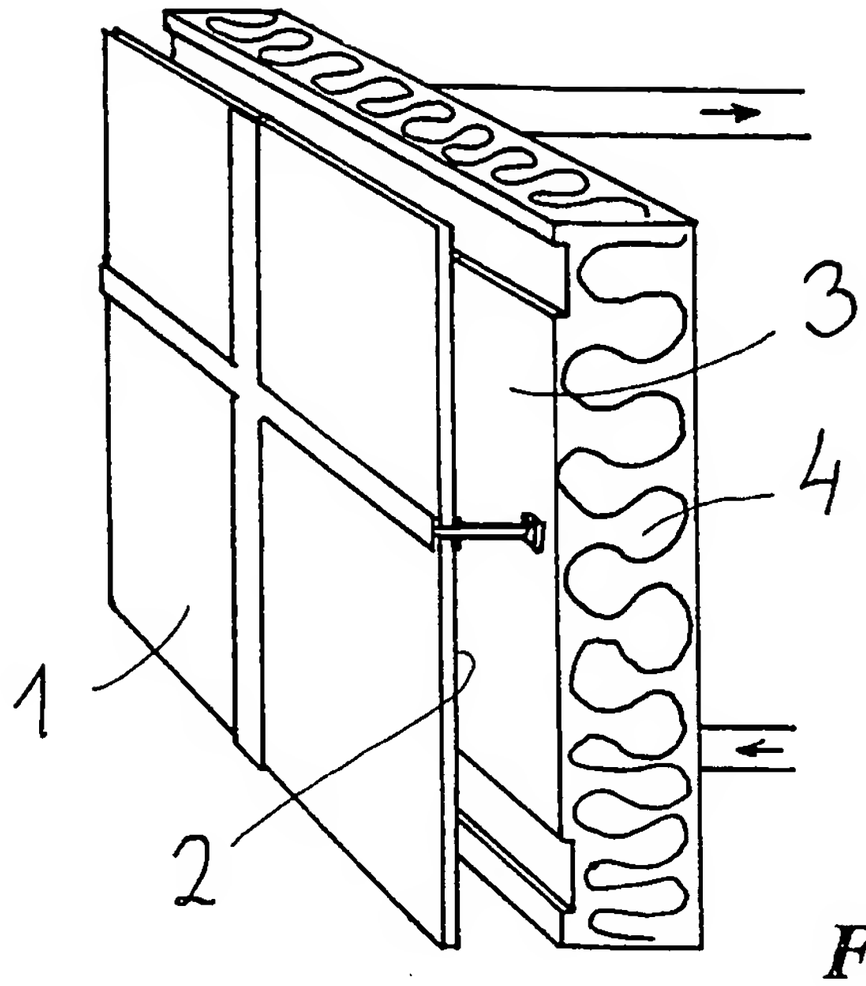

Fig. 1

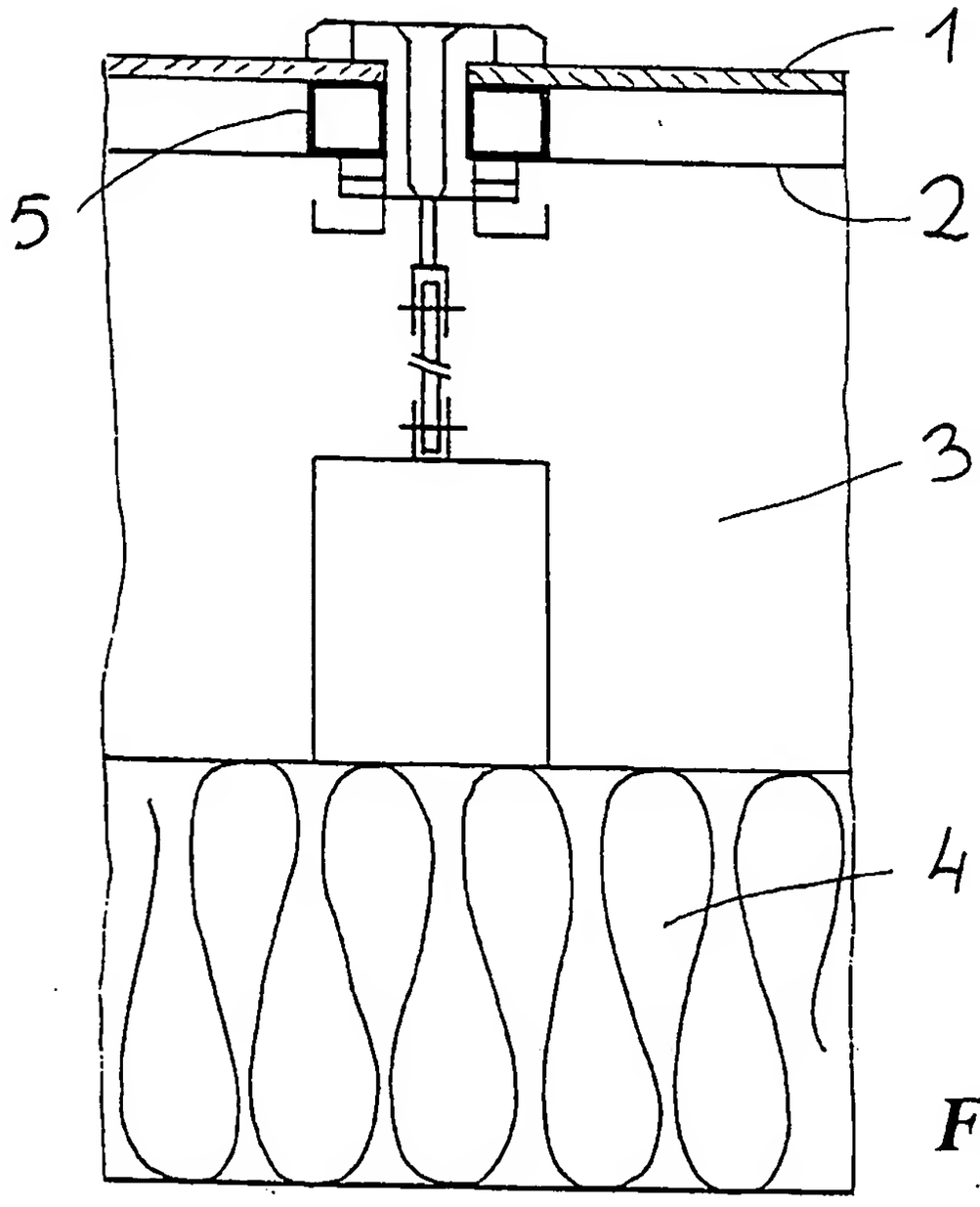

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00181

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24J 2/04, E04D 13/18
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F24J, E04B, E04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 3120794 A1 (ROSENDAHL, WILFRIED), 23 December 1982 (23.12.82), figure 1, abstract ---	1-5
A	EP 0473859 A1 (SEIDEL, GüNTHER), 11 March 1992 (11.03.92), column 7, line 1 - line 5, figures 4-6 ---	
A	EP 0626545 A1 (FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V.), 30 November 1994 (30.11.94), figure 1, abstract ---	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

27/07/98

International application No.
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DE 3120794 A1	23/12/82	NONE	
EP 0473859 A1	11/03/92	NONE	
EP 0626545 A1	30/11/94	DE 4317858 A,C	01/12/94
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